SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT WE, HIROYUKI KIMBARA, a citizen of Japan residing at Kanagawa, Japan, TOHRU HARADA, a citizen of Japan residing at Kanagawa, Japan and NOBUHITO INAMI, a citizen of Japan residing at Kanagawa, Japan have invented certain new and useful improvements in

INFORMATION PROCESSING APPARATUS STARTED FROM A PROGRAM RECORDED ON A RECORDING MEDIUM WITH WELL-MAINTAINED SECURITY, AND A RECORDING MEDIUM STORING SUCH A PROGRAM AND A PRODUCING METHOD OF SUCH A RECORDING MEDIUM

of which the following is a specification:-

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to an information processing technique and an image forming technique and, more particularly, to an information processing apparatus and an image forming apparatus that start a program from a recording medium inserted into a slot, and a program-starting method and a recording medium.

The present invention also generally relates to a recording medium producing technique and, more particularly, to a recording medium producing method, a recording medium producing apparatus and a recording medium producing system for producing a recording medium, which stores a program which an information processing apparatus is caused to start, and a recording medium produced according to such a recording medium producing method, recording medium producing apparatus or recording medium producing system.

2. Description of the Related Art

Information-processing apparatuses such as a personal computer performs various information processing operations by executing at least one program corresponding to the information processing operations. Moreover, an image forming apparatus (hereinafter

referred to as a combination machine) as an example of the information processing apparatus is provided with a display unit, a print unit, an picture-taking unit, etc. within a single housing, and also provided with four kinds of programs corresponding to a printer, a copier, a facsimile and a scanner so as to operate as a printer, a copier, a facsimile or a scanner by switching the programs to be executed.

Japanese Laid-Open Patent Application No. 2002-84383 discloses a combination machine as mentioned above.

In the information processing apparatus and the combination machine, a basic input/output system (BIOS) and a boot loader are started after turning a power on. The boot loader develops a Kernel and a root file system on a random access memory (RAM). Then, the kernel mounts the root file system. Here, the "mount" means a start of a file system or a peripheral device to operate in an accessible state.

After starting the kernel, a start program, which boots an application, is started. The start program is a process first started in an information-processing apparatus or a combination machine. The start program mounts a file system in accordance with a predetermined setting file and starts programs, which is

recorded on a hard disk unit (HDD), necessary for operations of the information processing apparatus or a combination machine in accordance with a predetermined setting file.

Recently, there is an increasing demand for starting a program of an information-processing apparatus or a combination machine from a recording medium such as an SD (secure digital) card, which is detachably attached to the information apparatus or the combination machine.

However, since a recording medium such as the SD card, which is removably attached, can be used with a personal computer, there may be an injustice to a program recorded on the recording medium, such as a tamper or a copy of the program recorded on the recording medium.

Therefore, when starting a program of an information-processing apparatus or a combination machine from a removable recording medium, there is a problem in that a security of a program stored in a recording medium cannot be well-maintained.

SUMMARY OF THE INVENTION

It is a general object of the present invention to provide an information processing apparatus

and a recording medium in which the above-mentioned problems are eliminated.

A more specific object of the present invention is to provide a technique to enable a start of a program from a recording medium while maintaining security of a program recorded on the recording medium.

In order to achieve the above-mentioned object, there is provided according to one aspect of the present invention an information processing apparatus comprising: a detector that detects a recording medium; a recording-medium starting section that activates the recording medium detected by the detector to be in an accessible state; and a program starting section that performs an authentication check on the recording medium, reads a program from the recording medium when a result of the authentication check is normal, and starts an execution of the program.

In one embodiment of the present invention, the information processing apparatus serve as image forming apparatus comprising: a detector that detects a recording medium; a recording-medium starting section that activates the recording medium detected by the detector to be in an accessible state; and a program starting section that performs an authentication check on the recording medium, reads a program relating to an

image formation from the recording medium when a result of the authentication check is normal, and starts an execution of the program.

Additionally, there is provided according to another aspect of the present invention a program starting method comprising: detecting a recording medium; activating the detected recording medium to be in an accessible state; and performing an authentication check on the recording medium, reading a program from the recording medium when a result of the authentication check is normal, and starting an execution of the program.

Further, there is provided according to another aspect of the present invention a recording medium used with an information processing apparatus capable of detecting the recording medium when loaded thereto, the recording medium storing at least one program that is read by the information processing apparatus and starting the read program when a result of an authentication check on the read program is normal after the recording medium is detected and activated to be in an accessible state and the authentication check is performed.

According to the above-mentioned invention, the authentication check is performed on the recording

medium before reading a program from the recording medium, and if the result of the authentication check is normal, the program recorded on the recording medium is read and started. Therefore, it can be determined whether or not the program recorded on the recording medium was subjected to an unfair practice prior to a start of the program, and, thus, a program that has not been subjected to an unfair practice can be selectively started.

Additionally, there is provided according to another aspect of the present invention a recording-medium producing method of producing a recording medium that stores a starting program which an information processing apparatus is caused to start, the recording-medium producing method comprising: producing license information using identification information of the recording medium; and recording the produced license information and the starting program on the recording medium.

Further, there is provided according to another aspect of the present invention a recording-medium producing method of producing an updating recording medium for updating a starting recording medium that stores a starting program to start an information processing apparatus, the recording-medium

producing method comprising: producing an updating program for updating a program which the information processing apparatus is caused to start; and recording the produced updating program on the updating recording-medium.

There is provided according to one aspect of the present invention a recording-medium producing apparatus of producing a starting recording medium that stores a program which an information processing apparatus is caused to start, comprising: a license information creation section that produces license information using identification information of the recording medium; and a recording section that records the produced license information and the program for starting on the starting recording medium.

Additionally, there is provided according to one aspect of the present invention a recording-medium producing apparatus of producing a starting recording medium that stores a program which an information processing apparatus is caused to start, comprising: a license information creation section that produces license information using identification information of the recording medium; and a sending section that sends the produced license information and the program for starting to a recording section that records the

produced license information and the program for starting on the starting recording medium.

Additionally, there is provided according to another aspect of the present invention a recording-medium producing apparatus of producing an updating recording medium for updating a starting recording medium that stores a program which an information processing apparatus is caused to start, comprising: an updating program creation section that produced an updating program that updates a program, which the information processing apparatus is caused to start, using identification information of the information processing apparatus; and a recording section that records the produced updating program on the starting recording medium.

Additionally, there is provided according to another aspect of the present invention a recording-medium producing apparatus of producing an updating recording medium for updating a starting recording medium that stores a program which an information processing apparatus is cause to start, comprising: an updating program creation section that produced an updating program that updates a program, which the information processing apparatus is caused to start, using identification information of the information

processing apparatus; and a sending section that sends the updating program to a recording section that records the produced updating program on the starting recording medium.

Further, there is provided according to another aspect of the present invention a recording-medium producing system of producing a starting recording medium that stores a program which an information processing apparatus is caused to start, comprising: a license information creation section that produces license information of the starting recording medium using identification information of the starting recording medium; and a recording section that records the produced license information and the program for starting on the starting recording medium, wherein the license information creation section and the recording section are connected to each other via a predetermined network.

Additionally, there is provided according to another aspect of the present invention a recording-medium producing system of producing an updating recording medium for updating a starting recording medium that stores a program which an information processing apparatus is caused to start, comprising: an updating program creation section that produced the

updating program using identification information of the information processing apparatus; and a recording section that records the produced updating program on the updating recording medium, wherein the updating program creation section and the recording section are connected to each other via a predetermined network.

Further, there is provided according to another aspect of the preset invention a recording medium for storing at least one program which an information processing apparatus is caused to start, wherein the recording medium stores license information produced using identification information of the recording medium and a starting program produced based on the identification information of the information processing apparatus and the program which the information processing apparatus is caused to start.

Additionally, there is provided according to another aspect of the present invention a recording medium for updating a starting recording medium that stores a program which an information processing apparatus is caused to start, the recording medium stores identification information of the information processing apparatus and an updating program that updates a program which the information processing apparatus is caused to start.

According to the above-mentioned present invention, the license information and the starting program, which can be easily justified, can be recorded on the starting recording medium that stores a program which the information processing apparatus is caused to start. Moreover, according to the above-mentioned invention, the updating program, which can be easily justified, can be recorded on the updating recording medium that is provided for updating the starting recording medium. Thus, according to the above-mentioned invention, the justice or validity of the program recorded on the recording medium can be easily checked, and, thereby, a start and update of the program from the recording medium can be achieved while maintaining a safety of the program recorded on the recording medium.

Other objects, features and advantages of the present invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of an information processing apparatus according to a first embodiment of the present invention;

FIG. 2 is a hardware structure diagram of the information processing apparatus according to the first embodiment of the present invention;

FIG. 3 is a block diagram of a structure of the combination machine;

FIG. 4 is a block diagram of a structure of the combination machine;

FIG. 5 is a structure diagram of an example of a combination machine starting section;

FIG. 6 is an illustration for explaining a start process of a program of the combination machine from an SD;

FIG. 7 is a flowchart of an example of an SD card insertion detection process;

FIG. 8 is a flowchart of an example of a process of an authentication check of a setting file;

FIG. 9 is an illustration showing an example of an object file recorded on an SD card;

FIG. 10 is an illustration showing an example of a setting file;

FIG. 11 is a flowchart of an example of a process of an authentication check performed on a module to be mounted;

FIG. 12 is a block diagram of a recording-medium creation system for producing a starting SD card;

FIG. 13 is a block diagram of another example of the recording-medium creation system for producing a starting SD card;

FIG. 14 is a sequence diagram showing a process procedure of the recording-medium creation system;

FIG. 15 is an illustration of an input screen displayed on a display device of a client;

FIG. 16 is a flowchart of a license information creation process;

FIG. 17 is a flowchart of a starting program creation process;

FIG. 18 is a block diagram of an example of the starting SD card;

FIG. 19 is an illustration of an example of the license information and the starting program recorded on the starting SD card;

FIG. 20 is a block diagram of another example of the starting SD card;

FIG. 21 is an illustration of license information and a starting program recorded on the starting SD card;

FIG. 22 is a block diagram of an example of the recording-medium creation system for producing the updating SD card;

FIG. 23 is a block diagram of another example of the recording-medium creation system for producing then updating SD card;

FIG. 24 is a sequence diagram of a process procedure of the recording-medium creation system;

FIG. 25 is a flowchart of an example of an updating program creation process;

FIG. 26 is a block diagram of an example of the updating SD card;

FIG. 27 is a flowchart of a process of starting a program from a starting SD card;

FIG. 28 is a flowchart of a process of performing an authentication check on the license information;

FIG. 29 is a flowchart of a process of performing an authentication check on the starting program; and

FIG. 30 is a flowchart of a process of updating the starting SD card in accordance with the updating SD card.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(First Embodiment)

A description will now be given of a first embodiment of the present invention. FIG. 1 is a block

diagram of an information processing apparatus according to a first embodiment of the present invention.

The information processing apparatus 1 shown in FIG. 1 comprises a software group 2, a starting section 3 and hardware resources 4. The starting section 3 is initially operated at the time of turning on a power of the information processing apparatus 1 so as to operate a program starting section mentioned later. The program starting section starts software in the software group 2 of the information processing apparatus 1. For example, the program starting section of the starting section 3 reads the programs of an SD card check section 11, a check result output section 13 and applications 14-1 to 14-n from an auxiliary memory device, and transfers the read programs to a memory device so as to start each program.

The hardware resources 4 include resources, such as an input device, a display device, an auxiliary memory device, a memory device, an interface device and a slot for SD cards. Moreover, the software group 2 includes the programs of the SD card check section 11, the check result output section 13 and the application 14-1 to 14-n that are operated on an operating system (OS) such as the UNIX (trademark). The OS concurrently controls the programs of the SD card check section 11,

the check result output section 13 and the application 14-1 to 14-n.

An application program interface (API) 15 is used to receive a request from the applications 14-1 to 14-n in accordance with previously defined functions. An engine interface (I/F) 16 is used to send a request to the hardware resources 4 in accordance with previously defined functions.

It should be noted that the SD card check section 11, the check result output section 13 and the program starting section will be explained later.

A description will now be given, with reference to FIG. 2, of a hardware structure of the information processing apparatus 1. FIG. 2 is a hardware structure diagram of the information processing apparatus according to the first embodiment of the present invention.

The information processing apparatus 1 comprises: an input device 21, a display device 22, an auxiliary memory device 23, a memory device 24, an operation processing apparatus 25, an interface device 26 and an SD card slot 27, which are connected to each other through a bus B.

The input device 21 includes a keyboard, a mouse, etc., so as to input various operation instructions to the information processing apparatus 1.

The display device 22 displays various windows, data, etc. used for operations. The interface device 26 is an interface for connecting the information processing apparatus 1 to a network, and comprises a modem, a router, etc.

An SD card can be removably inserted into the SD card slot 27. The SD card slot performs an interruption process on an SD card status monitor mentioned later in response to an insertion or removal of the SD card.

An auxiliary memory device 23 stores programs of the SD card check section 11, the check result output section 13 and applications 14-1 to 14-n that causes the information processing apparatus 1 to perform operations, and also stores various files, data, etc., which are required for the execution of the programs. The memory device 24 reads and stores the programs of the SD card check section 11, the check result output section 13 and applications 14-1 to 14-n from the auxiliary memory device 23 at the time of starting an operation of the information processing apparatus 1.

Then, the operation processing device 25 performs processes according to programs of the SD card check section 11, the check result output section 13 and applications 14-1 to 14-n stored in the memory device 24.

A description will now be given, with reference to FIG. 3, of a structure of a combination machine 31 as an example of application of the information processing apparatus 1 according to the first embodiment of the present invention. It should be noted that although an operation of the combination machine 31 will be mainly explained in the present embodiment, a similar operation is performed by the information processing apparatus 1.

FIG. 3 is a block diagram of a structure of the combination machine 31. The combination machine 31 comprises a software group 32, a combination-machine starting section 33 and hardware resources 34. The software group 32 includes an application layer 35 and a plat form 36 that are operated on an operating system (OS) such as the UNIX (trademark). Moreover, the hardware resources 34 include a monochrome laser printer (B&W LP) 41, a color laser printer (Color LP) 42 and other hardware resources 43 such as a scanner and a facsimile.

The application layer 35 includes a printer application 51, a copy application 52, a facsimile application 53, a scanner application 54 and a network file application 55. The plat form 36 includes a control service layer 37, a system resource manager

(SRM) 69 and a handler layer 38. The control service layer 37 interprets a process request from the application layer 35 so as to generate acquisition requests for the hardware resources 34. The SRM 69 manages the hardware resources 34 and arbitrates the acquisition requests from the control service layer 37. The handler layer 38 manages the hardware resources 34 in accordance with the acquisition requests from the SRM 69.

The control service layer 37 includes one or more service modules, such as a network control service (NCS) 61, a delivery control service (DCS) 62, an operation panel control service (OPS) 63, a fax control service (FCE) 64, an engine control service (ECS) 65, a memory control service (MCS) 66, a user information control service (UCD) 67 or a system control service (SCS) 68. It should be noted that the platform 36 is arranged to include an application program interface (API) 81. The OS carries out parallel execution of each software of the application layer 35 and the plat form 36 as a process.

The process of NCS 61 performs intermediacy at the time of transmitting and receiving data. The process of DCS 62 controls distribution of document data accumulated in the combination machine. The process of

OCS 63 controls an operation panel, which is an information communication means between an operator and a main controller. The process of FCS 64 provides an API for transmitting and receiving facsimile data. The process of ECS 65 controls the engine section of the hardware resources 34. The process of MCS 66 performs a memory control. The process of UCS 67 manages user information. The process of SCS 68 performs a process of controlling the system. The process of SRM 69 performs together with the SCS 68 a control of the system and a management of the hardware resources 34.

The handler layer 38 includes a facsimile control unit handler (FCUH) 70 which manages a facsimile control unit (FCU) mentioned later and an image memory handler (IMH) 71, which assigns a memory area to a process and manages the memory area assigned to a process. The SRM 69 and the FCUH 70 make a process request to the hardware resources 34 using the engine interface (I/F) 82. According to the structure shown in FIG. 3, the combination machine 31 is capable of performing processes common to the applications in a centralized manner at the platform 36.

A description will now be given, with reference to FIG. 4, of a hardware structure of the combination machine 31. FIG. 4 is a block diagram of a

structure of the combination machine 31. The combination machine 31 comprises a controller 100, an operation panel 120, a facsimile control unit (FCU) 121 and an engine section 122. The controller 100 includes a central processing unit (CPU) 101, a system memory 102, a north bridge (NB) 103, a south bridge (SB) 104, an application specification integrated circuit (ASIC) 106, a local memory 107, a hard disk drive unit (HDD) 108, a network interface card (NIC) 109, an SD card slot 110, an USB device 111, an IEEE1394 device 112, and a centronics 113.

The CPU 101 performs a control of the entire combination machine 31. For example, the CPU 101 starts and performs a process on the operating system. The NB 103 is a bridge. The SB 104 is a bridge for connecting a ROM, a peripheral device, etc. to a PCI bus 114. The system memory 102 is used as a memory for picture or the like in the combination machine 31. The local memory 107 is used as an image buffer or a code buffer for a copy.

The ASIC 106 is an IC for image-processing applications that has hardware components for image processing. The HDD 108 is an example of a storage device (an auxiliary memory device) which accumulates image data, document data, programs, font data, etc.

The NIC 109 is an interface device, which connects the combination machine 31 to the network.

An SD card is can be removably inserted into the SD card slot 110. The SD card slot performs interruption process on an SD card status monitor drive (mentioned later) in response to insertion or removal of the SD card. The USB device 111, the IEEE1394 device 112 and the centronics 113 are interfaces according to each standard specification.

The operation panel 120 is an operation unit, which received an input operation of an operator and displays information to the operator. It should be noted that the FCU 121 has a memory so as to temporarily store facsimile data that is received while a power of the combination machine 31 is off.

The combination machine starting section 33 shown in FIG. 3 is first operated at the time of turning on a power of the combination machine 31 so as to activate the application layer 35 and the platform 36. FIG. 5 is a structure diagram of an example of the combination machine starting section. The combination machine starting section 33 comprises a ROM monitor 130 and a program starting section 131.

The ROM monitor 130 serving as a BIOS and a boot loader is operated at the time of turning a power

on so as to perform an initialization of the hardware, a diagnosis of the controller 100 and an initialization of the software. The ROM monitor 130 develops the OS and the root file system on the system memory 102 so as to boot the OS. Then, the OS mounts the root file system.

The program starting section 131 is called from the OS, and acquires memory areas in the system memory 102 and the local memory 107. The program starting section 131 is a process first started in the combination machine 31 so as to mount a file system according to a predetermined setting file.

The program starting section 131 reads the programs of the application layer 35 and the platform 36 that are necessary for an operation of the combination machine 31 from the HDD 108, the OM or the SD card in accordance with a predetermined setting file, and starts the processes of the application layer 35 and the platform 36 by developing the read programs on the acquired memory areas of system memory 102 and the local memory 107.

A description will be given below of the process of the program starting section 131. The program starting section 131 reads a predetermined master setting file at the time of starting so as to mount the file system and start the process in

accordance with the read master setting file.

Moreover, if a description of the mount exists in the read master setting file, the program starting section 131 performs a mount process in accordance with the mount. Furthermore, if a predetermined setting file exists in the root of the mounted file system or if there is a predetermined directory containing a file having a predetermined extension in the root of the mounted file system, the program starting section 131 reads the predetermined setting file or the file having the predetermined extension so as to perform the mount process of the file system. It should be noted that there is a file system referred to as "gzromfs" or the like which the program starting section 131 can mount. The file system "gzromfs" mounts a gzip-compressed ROMFS file by developing it on a RAM.

A description will be given below of an example of a start process of a program of the combination machine 31 from an SD card. FIG. 6 is an illustration for explaining a start process of a program of the combination machine 31 from an SD. In FIG. 6, structures necessary to be explained are shown, and structures that do not need to be explained are omitted.

An SD card 136 is a recording medium that can be inserted into or removed from the SD card slot, which

is generally referred to as a plug and play, while a power of the combination machine 31 is turned on. The SD card slot 110 permits an insertion or removal of the SD card 136, and performs an interruption process on the SD card access driver 135 in response to an insertion or removal of the SD card 136. The SD card slot 110 has a function of a detector, which serves as detection means for detecting the SD card (recording medium) inserted into the SD card slot 110

The SD card access driver 135 performs an access control to the SD card 136, and notifies the SD card status monitor driver 134 of an insertion or removal of the SD card 136 in response to an interruption from the SD card slot 110. The SD card status monitor drive 134 manages status information of the SD card such as an insertion, removal, mount or unmount of the SD card 136, and notifies the program starting section 131 of the status information of the SD card 136.

The program starting section 131 starts an operation of the SD card check section 132 according to an insertion or removal of the SD card 136. Moreover, the program starting section 131 starts execution of the program in the SD card 136 according to the status information of the SD card 136 supplied from the SD card

status monitor driver 134. The SD card check section 132 checks consistency as a medium, that is, whether or not partitions are correct or whether or not the file system is correct, so as to cause the SD card 136 to be in a usable state. The SD card check section 132 has a checking function, a mounting function, an unmounting function, a status notifying function, etc., of the SD card 136. The SD card check section 132 serves as recording-medium starting means for activating the SD card (recording medium) 136 detected by the detection means to be in an accessible state. Moreover, the program starting section 131 serves as program starting means for performing the authentication check on the SD card (recording medium) 136, reading a program from the SD car 136 when a result of the authentication check is normal, and starting an execution of the read program.

A description will now be given, with reference to flowcharts, of a process procedure to read a program of the combination machine 31 from the SD card 136 and start the read program. The program starting section 131 is set in a state for waiting an event, after starting the processes of the application layer 35 and the platform 36 of the combination machine 32.

For example, if the SD card 136 is inserted into the SD card slot 110, the SD card access driver 135

notifies the SD card status monitor driver 134 of a detection of insertion of the SD cart 136 in response to the interruption by the SD card slot 110. The SD card status monitor driver 134 notifies the program starting section 131 of the detection of insertion of the SD card 136.

When the detection of insertion of the SD card 136 is notified buy the SD card status monitor driver 134, the program starting section 131 determines that there is an event, and, thus, performs a process of a flowchart shown in FIG. 7. FIG. 7 is a flowchart of an example of an SD card insertion detection process.

In step S10, the program starting section 131 activates the SD card check section 132. Then, the process proceeds to step S11, where the SD card check section 132 checks inconsistency of the SD card 136 as a medium, that is, whether or not the SD card 136 is operable normally.

If the result of the check of consistency is good (YES of S11), the process proceeds to step S12, where the SD card check section 132 mounts the SD card 136. Then, the SD card check section 132 notifies the SD card status monitor driver 134 that the mount of the SD card has been completed, and ends the process. On the other hand, if the result of check of consistency is

not good (NO of S11), the process proceeds to step S17, where the SD card check section 132 performs a predetermined error process.

When the program starting section is notified by the status monitor driver 134 that the SD card 136 has been mounted, the process proceeds to step S13, where the program starting section 131 performs, if there is a setting file in the mounted SD card 136, an authentication check of a setting file using an electronic authentication check library. It should be noted that the program starting section 131 returns to the event wait state, if there is no setting file in the mounted SD card 136.

The authentication check of the setting file is performed as a process shown in the flowchart of FIG. 8. FIG. 8 is a flowchart of an example of a process of the authentication check of the setting file. In step S20, the program starting section 131 determines whether or not there is an object file to be used for the authentication check of the setting file in the SD card 136.

The object file used for the authentication check of the setting file includes a setting file and an electronic signature file produced from the setting file and a message digest (hereinafter referred to as MD) of

a serial ID of the SD card. FIG. 9 is an illustration showing an example of the object file recorded on the SD card. In the example shown in FIG. 9, "printer.cnf" represents a setting file, "printer.lic" represents the electronic signature file used for the authentication check of the setting file, "printer.mod" represents a module file to be mounted, and "printer.mac" represents the electronic signature file used for the authentication check of the module to be mounted.

If it is determined that there is an object file to be used for the authentication check of the setting file (YES of S20), the program starting section 131 acquires the setting file and the electronic signature file used for the authentication check of the setting file from the SD card 136, and, thereafter, the process proceeds to step S21.

In step S21, the program starting section 131 acquires the serial ID of the SD card 136 from the SD card 136. Then, the process proceeds to step S22 where the program starting section 131 produces an MD1 corresponding to the setting file acquired in step S20 and the serial ID of the SD card 136 acquired in step S21. Then the process proceeds to step S23 where the program starting section 131 decrypts the electronic signature file acquired in step S20 with a public key so

as to produce an MD2.

Then, the process proceeds to step S24, where the program starting section 131 determines whether or not the MD1 produced in the step S22 is equal to the MD2 produced in the step S23. If it is determined that the MD1 produced in the step S22 is equal to the MD2 produced in the step S23 (YES of S24), the process proceeds to step S25 where the program starting section 131 makes a determination that the result of the authentication check of the setting file is OK.

On the other hand, if it determined that the MD1 produced in step S22 is not equal to the MD2 produced in step S23 (NO of S24), the process proceeds to step S26 where the program starting section 131 determines that the result of the authentication check is not good. This is because if the MD1 produced in step S22 is not equal to the MD2 produced in step S23, it is highly possible that the file recorded on the SD card 136 has been copied unjustly. It should be noted that if it determined that there is no object file to be used for the authentication check of the setting file (NO of S20), the routine proceeds to step S26 where it is determined that the result of the authentication check of the setting file is not good.

Returning to FIG. 7, if the result of the

authentication check of the setting file is good (YES of S13), the process proceeds to step S14 where the program starting section 131 performs an analysis of the setting file as shown in FIG. 10. On other hand, if the result of the authentication check of the setting file is not good (NO of S13), the process proceeds to step S17 where a predetermined error process is performed.

FIG. 10 is an illustration showing an example of the setting file. The setting file shown in FIG. 10 represents a process to mount a file "module/printer.mod" of a gzip-compressed ROMFS format to a mount point "/mnt/printer" and to execute the mounted module file.

Subsequent to step S14, the process proceeds to step S15 where the program starting section 131 performs, if there is a description of a mount in the setting file, an authentication check on the module to be mounted by using an electronic authentication check library. For example, the authentication check on the module to be mounted is performed according to a process shown by a flowchart of FIG. 11. FIG. 11 is a flowchart of an example of the process of the authentication check performed on the module to be mounted.

In step S30, the program starting section 131 determines whether or not the object file, which is used

for authentication check of the object to be mounted, exists in the SD card 136. The object file used for the authentication check of the module to be mounted includes a module file to be mounted and an electronic signature file produced from the module file and the MD of model information peculiar to the combination machine 31.

If it is determined there exists the object file to be used for the authentication check of the module to be mounted (YES of S30), the program starting section 131 acquires the module file to be mounted and the electronic signature file used for the authentication check of the module file to be mounted, and the process proceeds to step S31.

In step S31, the program starting section 131 acquires the model information peculiar to the combination machine 31. Then, the process proceeds to step S32 where the program starting section 131 produces the MD1 corresponding to the module file acquired in step S30 and the model information peculiar to the combination machine 31 acquired in step S31. Thereafter, the process proceeds to step S33 where the program starting section 131 decrypts the electronic signature file acquired in step S30 with a public key so as to produce the MD2.

Then, the process proceeds to step S34 where the program starting section 131 determines whether or not the MD1 produced in step S32 is equal to the MD2 produced in step S33. If it is determined that the MD1 produced in step S32 is equal to the MD2 produced in step S33 (YES of S34), the process proceeds to step S35 where the program starting section 131 determines that the result of the authentication check of the module to be mounted is good.

On the other hand, if it determines that the MD1 produced in step S32 is not equal to the MD2 produced in step S33 (NO of S34), the routine proceeds to step S36 where the program starting section 131 determines that the result of the authentication check of the module to be mounted is not good (NG). This is because if the MD1 produced in step S32 is not equal to the MD2 produced in step S33, it is highly possible that the file recorded on the SD card 136 has been subjected to an unfair practice such as a tamper or an unauthorized copy.

It should be noted that is it is determined that there exists no object file to be used for the authentication check of the module to be mounted (NO of S30), the process proceeds to step S36 where the program starting section 131 determines that the result of the

authentication check of the module to be mounted is not good (NG).

Returning to FIG. 7, if the result of the authentication check of the module to be mounted is good (OK) (YES of step S15), the process proceeds to step S16 where the program starting section 131 mounts the module to be mounted and performs the mounted module. It should be noted that if the result of the authentication check of the module to be mounted is not good (NG) (NO of step S15), the process proceeds to step S17 where a predetermined error process is performed.

It should be noted that the combination machine 31 is capable of notifying an operator by an LED display of a function button of functions that have become available due to the process of step S16. For example, a copy function and a scanner function can be indicated as being available by lighting the LED display of a copy button and a scanner button in blue. For example, a printer function and a facsimile function can be indicated as being available by lighting the LED display of the printer function button and the facsimile function button. The LED display of the copy function button, the scanner function button, the printer function button and the facsimile function button may be controlled by the SCS 68.

Although the combination machine 31 was mainly explained in the present embodiment, the technique according to the present invention is easily applicable to the information processing apparatus 1 shown in FIG. 1 and FIG. 2. In the information processing apparatus 1, the check result output section 13 may perform the process that is performed by the SCS 68 shown in FIG. 6.

(Second Embodiment)

A description will now be given, with reference to the drawings, of a second embodiment of the present invention. FIG. 12 is a block diagram of a recording-medium creation system for producing an SD card for starting.

In the recording-medium creation system 201 shown in FIG. 12, a client 210 and a recording-medium creation apparatus 230 are connected to each other through a networks 240 such as the Internet or a local area network (LAN).

The client 210 has an SD card slot into which the SD card 220 can be removably inserted. The client 210 receives license information and a starting program from the recording-medium creation apparatus 230 through the network 240, as mention later, and records the received license information and starting program on the

SD card 220 inserted in the SD card slot.

The recording-medium creation apparatus 230 comprises a communication section 231, a license information creation section 232, an electronic signature creation section 233, a starting program creation section 234, an effective program list 235, a private key 236 and a program 237. The communication section 231 is provided for enabling the recording-medium creation apparatus 230 to perform data communication with the client 210 through the network 40. The license information creation section 232 produces the license information based on the effective program list 235 and a first electronic signature produced from an SD serial ID of the SD card 220 and the effective program list 235.

The starting program creation section 234 produces the starting program from a second electronic signature, a model number of an information processing apparatus which starts a program from the SD card 220, and the program 237. The second electronic signature is produced from the model number of the information processing apparatus and the program which the information processing apparatus is cause to start, as mentioned later. The electronic signature creation section 233 produces the first electronic signature, by

using the private key 236, from the SD serial ID of the SD card 220 and the effective program list 235. The electronic signature creation section 233 also produces the second electronic signature, by using the private key 236, from the program 237, which is started by the information processing apparatus, and the model number of the image forming apparatus, which starts the program from the SD card 220.

It should be noted that the recording-medium creation system 1 shown in FIG. 12 may have a structure shown in FIG. 13. FIG. 13 is a block diagram of another example of the recording-medium creation system for producing an SD card for starting. The recording-medium creation system 202 shown in FIG. 13 is differs from the recording-medium creation system 201 shown in FIG. 12 in that the recording-medium creation apparatus is divided into a first recording-medium creation apparatus 250 and a second recording-medium creation apparatus 260.

For example, the first recording-medium creation apparatus 250 comprises a communication section 251, a license information creation section e52, a starting program creation section 253, an effective program list 254 and a program 255. The second recording-medium creation apparatus 260 comprises an electronic signature creation section 261 and a private

key 262. Since the communication section 251, the license information creation section 252, the starting program creation section 253, the effective program list 254, the program 255, the electronic signature creation section 261 and the private key 262 shown in FIG. 13 are equivalent to the communication section 231, the license information creation section 232, the starting program creation section 234, the effective program list 235, the program 237, the electronic signature creation section 233 and the private key 236 shown in FIG. 12, respectively, descriptions thereof will be omitted.

A description will now be given, with reference to FIG. 14, of a process procedure of the recording-medium creation system 201 shown in FIG. 12. FIG. 14 is a sequence diagram showing a process procedure of the recording-medium creation system. In step S210, an input screen 300 shown in FIG. 15 is displayed on a display device of the client 210. The input screen 300 has an input column 302 for inputting a model number and a button 303 for instructing a start of download.

A user operates an input device of the client 210 so as to input the model number in the input column 302 and click the button 303. The client 210 automatically reads an SD serial ID from the SD card 220

attached in the SD card slot. When the button 303 is clicked, the process proceeds to step S220 where the client 210 acquires the read SD serial ID and the model number input into input column 302 and sends the acquired SD serial number and model number to the recording-medium creation apparatus 230. After the license information creation section 232 of the recording-medium creation apparatus 230 receives from the client 210 the SD serial ID and the model number through the communication section 31, the process proceeds to step S30 where the license information creation section 232 produces license information using the SD serial ID and the model number.

FIG. 16 is a flowchart of a license information creation process. In step S231, the license information creation section 232 acquires the effective program list 235 corresponding to the model number. The effective program list 235 provides a list of programs that are usable by the information processing apparatus having the model number.

After acquiring the effective program list 235, the license information creation section 232 produces a message digest (hereinafter referred to as MD) from the SD serial ID and the effective program list 235, and sends the produced MD to the electronic signature

creation section 233. The electronic signature creation section 233 encrypts the received MD with a private key 236 so as to produce a first electronic signature, and sends the produced first electronic signature to the license information creation section 232. Then, the process proceeds to step S234 where the license information creation section 232 receives the first electronic signature from the electronic signature creation section 233, and produces the license information from the effective program list 235 acquired in step S231 and the received first electronic signature.

Returning to FIG. 14, when the starting program creation section 234 receives the model number from the client 210 through the communication section 231, the process proceeds to step S240 where the starting program creation section 234 produces a starting program using the model number.

FIG. 17 is a flowchart of a starting program creation process. In step S241, the starting program creation section 234 acquires the program 237 corresponding to the model number. The program 237 is a binary file, which can be used by the information processing apparatus having the model number concerned.

After the starting program creation section 234 acquires the program 237, the process proceeds to

step S342 where the starting program creation section 234 produces an MD from the model number and the program 237, and sends the produced MD to the electronic signature creation section 233. Then, the electronic signature creation section 233 encrypts the received MD with the private key 236, and produces a second electronic signature. The electronic signature creation section 233 sends the produced second electronic signature to the starting program creation section 234. Then, the process proceeds to step S244 where the starting program creation section 234 receives the second electronic signature from the electronic signature creation section 233, and produces a starting program from the program 237 acquired in step S241, the model number and the second electronic signature.

Returning to FIG. 14, after the license information creation section and the starting program creation section 234 of the recording-medium creation apparatus 230 produce the license information and the starting program, respectively, the process proceeds to step S250 where the license information and the starting program are sent to the client 210 via the communication section 231. Then, the process proceeds to step S260 where the client 210 records the license information and the starting program, which were received from the

recording-medium creation apparatus 230, on the SD card 220 inserted into the SD card slot.

According to the process procedure shown in the sequence chart of FIG. 14, the SD card for starting as shown in FIG. 18 is produced. FIG. 18 is a block diagram of an example of the SD card for starting. As shown in FIG. 18, the license information and the starting program are recorded on the SD card for starting. In the SD card for starting shown in FIG. 18, one piece of license information corresponds to one starting program. That is, one program is started based on one piece of license information.

FIG. 19 is an illustration of an example of the license information and the starting program recorded on an SD card for starting. The SD card for starting (hereinafter, referred to as a starting SD card) shown in FIG. 19 expresses the license information and the starting program for starting programs A and B.

The license information for starting the program A consists of "A.cnf" and "A.lic" recorded in a directory "init.d". "A.cnf" expresses the setting file 310. "A.lic" expresses the electronic signature file used for the authentication check on the setting file "A.cnf". For example, the setting file 310 expresses a process of mounting the program "module/A.mod" of a

ROMFS format, which has been gzip-compressed, to a mount point "/mnt/printer", and executing the mounted program A.

The starting program for starting the program A consists of "A.mod" and "A.mac" recorded in a directory "module". "A.mod" expresses the program A to start. "A.mac" expresses an electronic signature file used for the authentication check on the program A to start.

The license information for starting the program B consists of "B.cnf" and "B.lic" recorded in the directory "init.d". "B.cnf" expresses a setting file 320. "B.lic" expresses an electronic signature file used for the authentication check on the setting file "B.cnf". For example, the setting file 320 expresses a process of mounting the program "module/B.mod" of a ROMFS format, which has been gzip-compressed, to a mount point "/mnt/scanner", and executing the mounted program B.

Moreover, the starting program for starting the program B consists of "B.mod" and "B.mac" recorded in the directory "module". "B.mod" expresses the program B to start. "B.mac" expresses an electronic signature file used for the authentication check on the program B to start.

It should be noted that although the model number is included in the starting program recorded on the starting SD card shown in FIG. 19, the model number may be expressed in a different file.

Additionally, although one piece of license information corresponds to one starting program in the starting SD card shown in FIG. 18, one piece of license information may correspond to a plurality of starting programs as shown in FIG. 20. That is, a plurality of programs can be started based on one piece of license information. FIG. 20 is a block diagram of another example of the starting SD card. The starting SD card shown in FIG. 20 consists of one piece of license information and a plurality of starting programs.

FIG. 21 is an illustration of another example of the license information and the starting program recorded on the starting SD card. In the starting SD card shown in FIG. 10, one piece of license information starts programs A and B. For example, a setting file "A.cnf" represents a setting file 330. The setting file 330 describes a process of mounting a gzip-compressed program "module/A.mod" of ROMFS format to a mount point "/mnt/printer" and executing the mounted program A, and a process of mounting a gzip-compressed program "module/B.mod" of ROMFS format to a mount point

"/mnt/scanner" and executing the mounted program B. Other files are the same as the license information and start program, which are recorded on the starting SD card shown in FIG. 19, and descriptions thereof will be omitted.

A description will now be given, with reference to FIG. 22, of a recording-medium creation system for producing an SD card for updating the starting SD card. Hereinafter such an SD card for updating may be referred to as an updating SD card. FIG. 22 is a block diagram of an example of the recording-medium creation system for producing the updating SD card. In the recording-medium creation system 203, a client 210 and a recording-medium creation apparatus 230 are connected to each other through a network 240. The client 210 has an SD card slot into which an SD card 270 can be removable inserted. The client 210 receives an updating program from the recording-medium creation apparatus 230 through the network 240, and records the updating program on the SD card 270 inserted into the SD card slot.

The recording-medium creation apparatus 230 comprises a communication section 231, an electronic signature creation section 233, a private key 236, an updating program creation section 238 and a program 239.

The communication section 231 is provided for enabling the recording-medium creation apparatus to perform data communication with the client 210 through the network 240.

The updating program creation section 238 produces an updating program based on an electronic signature, a model number of an information processing apparatus and the program 239. The electronic signature is produced from the model number of the information processing apparatus, which starts the starting SD card, and the program 239, which updates the starting SD card. The electronic signature creation section 233 produces the electronic signature from the model number and the program 239 using the private key 236 as mentioned later.

It should be noted that the recording-medium creation system 3 of FIG. 22 may be of a structure shown in FIG. 23. FIG. 23 is a block diagram of another example of the recording-medium creation system for producing an updating SD card. The recording-medium creation system 204 differs from the recording-medium creation system 203 in that the recording-medium creation apparatus is divided into a first recording-medium creation apparatus 250 and a second recording-medium creation apparatus 260.

The first recording-medium creation apparatus

250 comprises a communication section 251, an updating program creation section 256 and a program 257. The second recording-medium creation apparatus 260 has an electronic signature creation section 261 and a private key 262.

The communication section department 251, the updating program creation section 256, the program 257, the electronic signature creation section 261 and the private key 262 shown in FIG. 23 are equivalent to the communication section 231, the updating program creation section 238, the program 239, the electronic signature creation section 233 and the private key 236 shown in FIG. 22, respectively, and descriptions thereof will be omitted.

A description will now be given, with reference to FIG. 24, of a process procedure of the recording-medium creation system 203 shown in FIG. 22. FIG. 24 is a sequence diagram of a process procedure of the recording-medium creation system.

In step S310, an input screen provided with an input column for inputting a model number and a button for instructing a start of a downloading operation is displayed on the display unit of the client 210. A user inputs a model number into the input column by operating the input device and clicks the button for instructing a

start of a downloading operation. When the button is clicked, the process proceeds to step S320 where the client 210 acquires the model number input in the input column and sends the acquired model number to the recording-medium creation apparatus creation apparatus 230.

After the updating program creation section 238 of the recording-medium creation apparatus 230 receives the model number from the client 210 through the communication section 231, the process proceeds to step S330 where the updating program creation section 238 produces an updating program.

FIG. 25 is a flowchart of an example of an updating program creation process. In step S331, the updating program creation section 238 acquires the program 239 corresponding to the received model number. The program 239 is a binary file, which is usable by an information processing apparatus corresponding to the model number concerned.

Then, the process proceeds to step S332 where the updating program creation section 238 produces an MD from the program 239, and sends the produced MD to the electronic signature creation section 233. The electronic signature creation section 233 encrypts the received MD with the private key 236 so as to produce an

electronic signature. The electronic signature creation section 233 sends the produced electronic signature to the updating program creation section 238.

Then, the process proceeds to step S334 where the updating program creation section 238 receives the electronic signature from the electronic signature creation section 233, and produces an updating program from the electronic signature, the model number and the program 239 acquired in step S331.

Returning to FIG. 24, after the updating program creation section 238 of the recording-medium creation apparatus 230 produces the updating program, the process proceeds to step S340 where the updating program creation section 238 sends the updating program to the client 210 through the communication section 31. Then, the process proceeds to step S350 where the client 210 records the updating program received from the recording-medium creation apparatus 230 on the SD card 270 inserted into the SD card slot.

According to the process procedure shown in FIG. 24, the updating SD card shown in FIG. 26 is produced. FIG. 26 is a block diagram of an example of the updating SD card. As shown in FIG. 26, the updating program is recorded on the updating SD card. The starting SD card and the updating SD card mentioned

above are inserted into an SD card slot provided in an information processing apparatus or a combination apparatus and used for starting a program or updating a program.

A description will be given below, with reference to FIG. 27, of a process when the starting SD card or the updating SD card is inserted into a combination machine. FIG. 27 is a flowchart of a process of starting a program from a starting SD card.

In step S410, the combination machine reads license information from the starting SD card inserted in the SD card slot, and perform an authentication check on the license information. If it is determined that the result of the authentication check on the license information is good (OK) (YES of step S410), the process of the combination machine proceeds to step S420. On the other hand, if it is determined that the result of the authentication check on the license information is not good (NG) (NO of step S410), the process of the combination machine proceeds to step S440 where an error process is performed, and, then, the process is ended.

In step S420, the combination machine reads the starting program from the starting SD card inserted in the SD card slot, and performs an authentication check on the starting program as mentioned later. If it

is determined that the result of the authentication check on the starting program is good (OK) (YES of step S420), the process of the combination machine proceeds to step S430. On the other hand, if it is determined that the result of the authentication check on the starting program is not good (NG) (NO of step S420), the process of the combination machine proceeds to step S240 where the error process is performed, and, then, the process is ended.

In step S430, since both the authentication check on the license information and the authentication check on the starting program are good (OK), the combination machine starts the program recorded on the starting SD card, and, then, the process is ended. For example, the authentication check on the license information is performed in a manner shown in a flowchart of FIG. 28.

FIG. 28 is a flowchart of a process of performing an authentication check on the license information. In step S411, the combination machine determines whether or not the object file, which the combination machine uses for the authentication check on license information, exists in the starting SD card. The object file used for the authentication check on the license information contains an effective program list

and a first electronic signature.

If it is determined that the object file used for the authentication check on the license information exists (YES of step S411), the combination machine acquires the effective program list and the first electronic signature from the starting SD card, and the process proceeds to step S412. In step S412, the combination machine acquires an SD serial ID from the starting SD card. Then, the process proceeds to step S413 where the combination machine produces an MD based on the effective program list acquired in step S411 and the SD serial ID acquired in step S412.

Thereafter, the process proceeds to step S414 where the combination machine decrypts the first electronic signature acquired in step S414 with a public key. Then, the process proceeds to step S415 where the combination machine determines whether or not the MD1 produced in step S413 is equal to the MD2 produced in step S414. If it is determined that the MD1 produced in step S413 is equal to the MD2 produced in step S414 (YES of S415), the process of the combination machine proceeds to step S416 where a determination is made that the result of the authentication check on the license information is good (OK). On the other hand, if it is determined that the MD1 produced in step S413 is not

equal to the MD2 produced in step S414 (NO of S415), the process of the combination machine proceeds to step S417 where a determination is made that the result of the authentication check on the license information is not good (NG). This is because that if it is determined that the MD1 produced in step S413 is not equal to the MD2 produced in step S414, it is highly possible that the file recorded on the starting SD card has been falsely copied.

It should be noted that if it is determined that there is no object file used for the authentication check on the license information (NO of step S411), the process proceeds to step S417 where the combination machine determines that the result of the authentication check on the license information is not good (NG).

The authentication check on the starting program is performed according to a flowchart shown in FIG. 29. FIG. 29 is a flowchart of a process of performing the authentication check on the starting program.

In step S421, it is determined whether or not there is an object file which the combination machine uses for the authentication check on the starting program in the starting SD card. The object file used for the authentication check on the starting program

contains a program and a second electronic signature. If it is determined that there exists the object file used for the authentication check on the starting program (YES of step S421), the combination machine acquires the program and the second electronic signature from the starting SD card, and then, the process proceeds to step S422.

In step S422, the combination machine produces an MD1 of the program acquired in step S421. Then, the process proceeds to step S423 where the combination machine decrypts the second electronic signature acquired in step S421 with the public key so as to produce an MD2. Then, the process proceeds to step S424 where the combination machine determined whether or not the MD1 produced in step S422 is equal to the MD2 produced in step S423.

If it is determined that the MD1 produced in step S422 is equal to the MD2 produced in step S423 (YES of step S424), the process proceeds to step S425 where the combination machine determines that the result of the authentication check on the starting program is good (OK). On the other hand, if it is determined that the MD1 produced in step S422 is not equal to the MD2 produced in step S423 (NO of step S424), the process proceeds to step S426 where the combination machine

determines that the result of the authentication check on the starting program is not good (NG). This is because that if the MD1 produced in step S422 is not equal to the MD2 produced in step S423, it is highly possible that the file recorded o the starting SD card is falsely copied or tampered. It should be noted that if it is determined that there is no object file used for the authentication check on the starting program (NO in step S421), the process proceeds to step S426 where the combination machine makes a determination that the result of the authentication check on the starting program is not good (NG).

FIG. 30 is a flowchart of a process of updating the starting SD card in accordance with the updating SD card. In step S510, the combination machine reads the starting program from the updating SD card inserted in the SD card slot, and performs the authentication check on the updating program according to a flowchart shown in FIG. 30.

If it is determined that the result of the authentication check on the updating program is good (OK) (YES of step S510), the process of the combination machine proceeds to step S520. On the other hand, if it is determined that the result of the authentication check on the updating program is not good (NG) (NO of

step S510), the process of the combination machine proceeds to step S530 where an error process is performed, and, then, the process is ended. That is, the combination machine ends the process without updating starting SD card inserted in a different SD card slot.

On the other hand, in step S520, the combination machine updates the SD card inserted in the different SD card slot using the program recorded on the updating SD card since the result of the authentication check on the updating program was good (OK), and then, the process is ended. The starting SD card and the updating SD card according to the preset invention can record the license information and the starting program, of which credibility can be easily checked. Therefore, a start or an update of a program from a removal recording medium such as an SD card can be performed while a security of a program recorded on the removable recording medium is well-maintained.

The present invention is not limited to the specifically disclosed embodiments, and variations and modifications may be made without departing from the scope of the present invention.

The present application is based on Japanese patent applications No. 2003-076607 filed March 19, 2003,

No. 2003-076680 filed March 19, 2003, No. 2004-70193 and No. 2004-70194, the entire contents of which are hereby incorporated by reference.